Process Innovation, Alliances, and the Interplay of Firm Age: Early Evidence from Italian Small Firms

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Abstract

We investigate whether and how process innovation of small enterprises is influenced by allying with another firm. Drawing on resource-based view of the firm and integrating findings from studies on the liabilities of age and newness, we argue: 1) for a direct association between strategic alliances and process innovation, and 2) in favor of a moderating role of firm age on this relationship. The results from a representative sample of 159 Italian small firms shed new light on the role of strategic alliances in explaining process innovation, and support this proposal. We find a significant and positive relationship between strategic alliances and process innovation, and a moderating effect of firm age on this relationship. This suggests that a younger firm benefits more than an older one from the increase in process innovation activities occurring as a result of alliances with other firms. The age of the firm appears to dictate the nature of relationship between strategic alliances and process innovation. Significant and novel theoretical and managerial implications are discussed.

Keywords: process innovation, alliances, resource-based view, small firms, competitive advantage

1. Introduction

Among strategic management, innovation, and entrepreneurship researchers studying firm level innovativeness as a behavior and an outcome, process innovation (hereafter PI) has emerged as an important construct for explaining performance differences across firms (Christensen & Raynor, 2003; Damanpour, 1991; Piening & Salge, 2015; Zahra, 1996). Although researchers have diversely conceptualized the content and character of PI and its performance effects (Capon, Farley, Lehmann, & Hulbert, 1992; Ettlie & Reza, 1992; Utterback & Abernathy, 1975; Zahra, Neubaum, & Huse, 2000), it is often considered as an important firm critical resource because firms need to build and maintain innovativeness capabilities, to sustain their competitive advantage and secure economic rent (Barney, 1991; McGrath, Tsai, Venkataraman, & MacMillan, 1996; Wernerfelt, 1984). In this research, we view PI as an organizational outcome (Crossan & Apaydin, 2010), defined as 'new tools, devices, and knowledge in throughput technology' (Gopalakrishnan, Bierly, & Kessler, 1999: 148) collectively designed and developed as a critical resource (Berney,1991) to create and sustain a competitive advantage.

Research generally builds on the assertion that due to heterogeneity of resources (Penrose, 1958) and diversity of their endowments among firms (Wernerfelt, 1984), some firms are more motivated, compared to others, to ally with another one, despite inherent risk and uncertainty involved (Li, Qian, & Qian, 2013), to access lacking desired resources and assets in order to adapt and change to meet new market imperatives. Consistent with this view, Das and Teng (2000) note that, according to RBV, strategic alliances can be viewed as 'voluntary cooperative inter-firm agreements aimed at achieving competitive advantage for the partners" (2000:33), thus entailing the development of critical while shedding old and redundant processes and system not in match with new market needs (Haeussler et al., 2012; Huergo and Jaumandreu, 2004a; McGrath et al., 1996).

Because resource endowments differ among firms (Wernerfelt, 1995), strategic alliance is a pragmatic solution as compared to such other decisions as mergers and acquisitions, and joint ventures. Indeed, researchers broadly acknowledge performance effect of strategic alliances (e.g. Gulati, 1995; Lahiri & Narayanan, 2013; Rothaermel & Deeds, 2006) and many studies have specified the contingencies that interplay in shaping this effect (Aldrich & Auster, 1986; Eisenhardt & Schoonhoven, 1996; Joshi & Nerkar, 2011; Lahiri & Narayanan, 2013; Stinchcombe, 1965).

In parallel, theory and evidence about specific mechanisms that govern the contribution of an alliance to PI have

generally been lacking. Specifically, while it is acknowledged that, in order to implement process innovation SMEs may have alternatives to internal development that enable them to bridge the resource gap that exists with large firms (Miles, Preece, & Baetz, 1999), there remains a need to better understand what specific role a strategic alliance may have on process innovation (Edwards, Delbridge, & Munday, 2005). In an effort to enrich theoretical understanding of alliances and PI, we propose a deeper explanation based on the premise that PI, from a resource-based perspective, represents a value-creating resource combination (Mendoza Moheno, Hernández Calzada, & Salazar Hernández, 2014; Piening & Salge, 2015).

Specifically, companies, particularly small and young, constantly face the challenge to ensure to have access to critical resources, such as PI, necessary to build and maintain a competitive position in their market. Scholars agree that such a challenge can be attributed to differences in resource endowment (Wernerfelt, 1995) and to such liability attributes as age and size (Aldrich & Auster, 1986; Stinchcombe, 1965).

By and large, managers of younger and small companies may find themselves in greater need and motivation, as compared to older and larger ones, to pursue strategic collaboration with another firm to alleviate the pressure of the latter challenges (Colombo, Grilli, Murtinu, Piscitello, & Piva, 2009; Hughes, Morgan, Ireland, & Hughes, 2014). Managers pursue these strategic actions to ensure access to otherwise inaccessible valuable resources, achieve more operational and commercial efficiencies, have enhanced legitimacy, and share investment risks (Andreini, 2010; Andreini & Pedeliento, 2014). For the allying firm, to have access to these valuable resources will not only complement resources it already has but also foster its competitive and economic growth (Ramanathan, Seth, & Thomas, 1997). Collectively, these resources could allow the company to enhance its innovativeness and competitive aspiration of developing and offering novel products and services and to ensure better fit within its dynamic environment (Doz & Hamel, 1998). Consistent with this stance, research on liabilities of age and newness implicitly indicates that resources are essential in building and sustaining a firm's competitive advantage and economic rent (McGrath et al., 1996), and that process innovation is one of the drivers. According to the liability of age, scholars have emphasized that young firms need to collaborate with others to sustain competitive advantage and ensure survival (Aldrich & Auster, 1986).

Therefore, in this research we investigate 1) whether and how, in small firms, an alliance formation influences process innovation and 2) how firm age influences this relationship. Building on resource-based view (RBV), and integrating literatures on liabilities of age (Aldrich & Auster, 1986; Aldrich & Fiol, 1994; Stinchcombe, 1965) we argue for a direct association between a strategic alliance and process innovation [framed in this this research as an outcome] (Crossan & Apaydin, 2010; Damanpour, 1991). We further suggest that to have a clear picture of the relationship between a strategic alliance and process innovation, it is fundamental to account for a key feature such as the age of a firm. Empirically, we test our proposed hypotheses on a sample of Italian small firms and find support for our main arguments. Our choice to focus on a context of small firms allows us to explain the development of PI in a context where strategic decisions and implementation of innovative processes is challenging due to organizational constraints such as access to important resources (Aldrich & Auster, 1986).

The remainder of the paper is organized as follows. In the next section, we differentiate process innovation as a critical resource of the firm in building and sustaining competitive advantage. We then provide an overview of firm-level innovativeness, conceptualized in this research as a process innovation outcome of allying with another firm, and the interplay of age. This is followed by detailed arguments leading to a set of tested hypotheses. Finally, the discussion sets out the implications of our findings for future research.

2. Resource-based View and Process Innovation

The primary virtue of RBV (Penrose, 1958) lies in its ability to describe the actions of a firm vis-à-vis its competitors, while acknowledging its capital (physical, human, and organizational), its resources, endowments of these resources (Barney, 1991; Wernerfelt, 1984), and their skill sets particularly within global dynamics (Hamel, 1991). These bundles of resources and skill sets are idiosyncratic and make the firm's strategic assets. A key success factor is what and how a firm can create and appropriate such valuable assets to build new revenue avenues while sustaining and maximizing benefits from existing ones. RBV further assumes that firms not differ in their endowment of resources skills but also in the scale and scope such resources and capabilities are heterogeneous, and therefore, creating differing competitive advantage (Barney, 1991). Researchers also concur that to build and sustain competitive advantage (Barney, 1991), innovation is a fundamental antecedent to economic rent (McGrath et al., 1996) and particularly with a dominating global competitive atmosphere (Hamel, 1991; Peteraf, 1993). Consistent with this view, Crossan and Apaydin (2010:1155) note that the whole point of innovation is about 'production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets, development of new methods of production; and establishment of new management systems' collectively form the base to build competitive advantage (McGrath et al., 1996). This is so because '…valuable and rare organizational resources

can only be a source of sustained competitive advantage if firms that do not possess these resources cannot obtain them' (Barney, 1991, p.107).

This stance echoes with Schumpeterian competition, a state far from a stable competitive dynamics and with elements of uncertainty, where it is only through innovation that a firm can renew its resources (Schumpeter, 1950) particularly in the way they are reconfigured, combined and utilized (Penrose, 1958). Firms do not possess the same resources, skills, and complete information due to heterogeneity of resources and information distribution. Since "…some irreducible uncertainty remains in an industry, firms will be unable to anticipate perfectly which particular changes in an industry will cause a revolution or which firm or firms will be the sources of this change" (Barney,1986, p.796). As such, it is impossible for firms to develop identical idiosyncratic resources and skills.

Leading innovative firms use strategic forward-thinking and efforts to successfully develop idiosyncratic capacities and resources that are combined and routinized (Nelson & Winter, 1982). Other firms that possess different and relatively less competitive idiosyncratic resources and capacities could adapt and follow the lead, while those that lack either will simply disappear. The strategic significance of PI as a firm's critical resource is that it represents ongoing change in value creation and or appropriation. In other words, PI represents itself a value-creating resource and it is an organizational driver for building and sustaining a competitive advantage. A firm constantly allocates and invests in innovation-related resources about which competitors are less informed or aware. As the firm implements innovation, and specifically PI, it secures a flow of unique resources that further builds up its strategic assets, making it even more difficult for competitors to replicate (Dierickx & Cool, 1989). In turn, this sustains its competitive advantage (McGrath et al., 1996).

3. Strategic Alliances and Process Innovation

The existence of different degrees of heterogeneity of resources and skills –including PI- among companies,   creates strategic needs and opportunities for alliance formation to gain and sustain competitive advantage and success (Eisenhardt & Schoonhoven, 1996). Such an objective requires firms to secure, and have access to, a flow of resource endowments, which is essential to build a competitive advantage (Barney, 1991). Creating and sustaining a competitive advantage is essential for today's organizations and within a dominating global competitive dynamics. Managing and developing the organizational repertoire of resources and processes necessary for continuous flow of competitive new products and services is, however far from straightforward. The most carefully developed innovative resources and processes –including that of PI- often disintegrate because of various endogenous and exogenous factors. It is broadly acknowledged among scholars and practitioners that firms increasingly compete for scarce resources. To ally with another firm has therefore become instrumental in enabling firms to compete successfully in rapidly-changing global markets (Bergamaschi & Magno, 2015; Doz & Hamel, 1998) or the effect of alliances on supply chain network (Bergamaschi & Renoldi, 2015).

The importance of knowing the effects of an alliance has given rise to a large number of studies (Mowery, Oxley, & Silverman, 1998). For example, some scholars studied the effects of strategic alliances on performance, reflected in the number of patents (Shan, Walker, & Kogut, 1994), product innovation (George, Zahra, & Wood, 2002; Haeussler et al., 2012), international sales (Leiblein & Reuer, 2004), and even long-term performance (Compagni, Gerzeli, & Bergamaschi, 2011; Vagnani, 2015). Other researchers studied different aspects of strategic alliances such as how an organization manages its capabilities and experiences within an alliance (Rothaermel, 2001; Rothaermel & Deeds, 2006), and the influence of the organization's social context on alliance strengths and weakness (Ahuja, Polidoro, & Mitchell, 2009; Baum et al., 2000).

While most of theoretical framing underpinning studies of strategic alliances is drawn from a transaction cost perspective (Geyskens, Steenkamp, & Kumar, 2006), less so from resource-based view (Eisenhardt & Schoonhoven, 1996; Yasuda, 2005). Scholars have also examined the extent to which strategic alliance antecedents and outcomes are influenced by organizational characteristics such as motives-R&D based alliances, market-access alliances (Mowery et al., 1998), and size (Aldrich & Auster, 1986; Stinchcombe, 1965) among others.

If a firm can create, have access to, and mobilize important resources, timely and in an efficient way, these strategic actions (i.e., to ally with another firm) will shape its growth and survival path. In essence, an organization that does not sustain and build a repertoire of innovative processes to match contemporary and changing factors will not only experience disruptions in product or service delivery, but will also be prone to its resources and competences, skills and capabilities becoming outdated. Ultimately, such firms will experience constrained growth or even failure. These unfavorable outcomes are more pronounced in small firms because they experience naturally-limiting factors such as lack of resources (Aldrich & Auster, 1986; Stinchcombe, 1965). Specifically, small firms find it more difficult to access strategic resources due to these limiting factors. A small firm, therefore, allies with one or more partners to mitigate the impact of these issues. Both partners gain access to knowledge, technology, and market resources. This collaboration

provides access to multi-faceted resources, so will influence the organizations' internal environment and attributes, including development of process innovation. We therefore expect that:

Hypothesis 1(H1): In small firms, there will be a positive association between a firm's pursuit of a strategic alliance and its development of PI.

4. Firm Age and Process Innovation

Scholars have consistently argued that age has an influential role in a firm's strategic endeavors for renewal and change. While findings reveal both positive and negative influences of age on companies, scholars broadly acknowledge that a younger firm changes more often than an older one (de Figueiredo, Rawley, & Rider, 2015). One school of thought, led by Stinchcombe (1965), and supported by many more recent studies (for a review, please see (Baum et al., 2000) argues that younger firms experience more constraints in access to resources and market position instability because of "newness". The young firm, unlike an older one, is limited in its resources, and still developing its knowledge repertoire and know-how (Nelson & Winter, 1982). Its production system operations are not only at an early stage of development but also not yet crystalized as standardized routines (Eisenhardt & Schoonhoven, 1990).

Another school of thought relates these issues and constraints to the industry life cycle (Utterback & Abernathy, 1975). Utterback and Abernathy (1975) note that in a younger firm, strategic and competitive activities pertinent to process innovation will only be prioritized after product-performance strategies, and then sales maximization strategies, have been designed and implemented. Consequently, while older firms have a time-based advantage to focus on process innovation strategies, younger firms do not enjoy this privilege. This age-related differentiation, between older and younger firms, to develop and foster process innovation is even more pronounced in highly dynamic and hostile environments. This "newness" perspective offers an explanation for variation among firms, based on time-related maturity. As the firm matures over time, managers focus more on strategies pertinent to process innovation, presumably because they have secured competitive advantage from aggregated market experience and the strength of the firm's position (Pfeffer & Salancik, 2003; Stinchcombe, 1965). For instance, Miyazaki (1994) showed that innovation capability, along with firms' learning processes, increases over time. Older firms may also benefit from increased managerial ability to manage uncertainty, and achieve better market position and legitimacy (Withers, Drnevich, & Marino, 2011) and therefore are more likely to have secured, and appropriately allocated, more resources such as an experienced workforce (Edwards, Delbridge, & Munday, 2005; Weick, 1979).

Scholars also debate the liability of ageing from the stance that firms have a tendency to expend significant effort and resources mastering skills needed to secure immediate profit and economic returns. These investments are often committed at the expense of developing new competences that could strengthen future performance. The result is that the firm is stuck in a "competency trap" (Levinthal & March, 1993). Thus, the organizational inertia created imposes difficulty and cost factors for a firm to adjust to market needs once the investment has been made (Winter and Nelson, 1982). Bureaucratic structures, including established routines, processes, and practices, may lead to a core rigidity (Leonard-Barton, 1992). Increased institutionalization, over time, increases the cost of exploring opportunities for innovation (Anderson & Tushman, 1990). As firm age tends to reduce fit between an organization and its environment (Hannan & Freeman, 1984), the gap between organizational competencies and market increases. As a result, these competencies become outdated and obsolete (Barron, West, & Hannan, 1994). Empirically, researchers have found that this has a negative influence on innovation outputs such as the number of new products by units of sale and the proportion of innovative sales (Hansen, 1992). Similarly, Huergo and Jaumandreu, (2004a), using a wide sample of manufacturing firms, found that younger firms tend to be more likely than older ones to introduce innovations. Being young therefore outweighs the "newness" factor and enables the firm to be more entrepreneurial. In another study, the same researchers found that new companies performing process innovation have a higher rate of productivity growth, which, in turn, tends to converge to a common (activity-specific) growth rate with age (Huergo & Jaumandreu, 2004a).

Younger small firms generally enjoy higher levels of entrepreneurship, flexibility, and rapid response than their older cousins, internal conditions that encourage increased focus on product performance and sales-maximizing innovation (Withers, Drnevich, & Marino, 2011). By contrast, older firms, because of the advantage of time, develop routines and procedures that may be barriers to innovation in general (Nieto and Santamaria, 2010), but not to process innovation in particular. We therefore propose:

Hypothesis 2 (H2): In small firms, there will be a negative association between firm age and its development of PI.

5. Exploring the Contingent Effect of Age for SA-PI Association

Up to this point, a basic assumption has been that the process innovation effects of firm strategic alliances are not contingent on context-specific endogenous influencers on the firm. In this section, we relax this rather simplistic assumption. It is reasonable to consider the impact of age on the direct association between strategic alliances and

process innovation. Specifically, if a firm decides to ally with another to enhance its innovation capabilities, it is likely that firm age will be a significant contingent factor. Some studies show that younger firms are not only faster to identify new opportunities to innovate but also less experienced, and so acquire more knowledge and new practices from alliances, resulting in improved efficiency and skills (Chase, Aquilano, & Jacobs, 2001; Hannan & Freeman, 1984). This means that they have a better opportunity for innovation than older firms.

Younger firms possess different characteristics which influence an alliance and its pertinent relationships. First, while these firms have less specialized but more flexible resources, older firms possess more specialized resource-base and are not incentivized to enter into an alliance because they can proactively promote innovation (Amit & Zott, 2012; Thornhill & Amit, 2003). In addition, mature firms have established routines that younger firms lack (Bruderl and Schussler, 1990; Freeman, Carroll, & Hannan, 1983). Core competencies of mature firms, including firm-specific knowledge, could become a source of a core rigidity (Leonard-Barton, 1992; Van de Ven, Polley, Garud, & Venkataraman, 2007). Empirical evidence indicates that older firms tend to innovate by exploiting existing knowledge rather than exploring new opportunities (Sørensen & Stuart, 2000; Thornhill & Amit, 2003). These older firms have a wider range of prior experience that allows them to avoid improvisation (Zahra, Sapienza, & Davidsson, 2006). Over time, firms tend to formalize their operative procedures and acquire more mechanistic structures that allow them to maintain their past competitive strengths and repeat successful strategies (Miller & Chen, 1994; Zahra, 2012).

These characteristics pertinent to firm age affect its influence on the development of innovative processes during strategic alliances. In other words, the age of a small firm may dictate the way it approaches collaboration opportunities over time. The age factor therefore helps to explain the extent to which a firm benefits from its collaboration with other partners to develop its repertoire of process innovation (Wales, et al., 2011). We therefore propose that:

> *Hypothesis 3 (H3): The age of the firm moderates the association between strategic alliances and PI. Specifically, for younger small firms, gains from strategic alliances to develop PI are strengthened; but such gains are weakened for older small firms.*

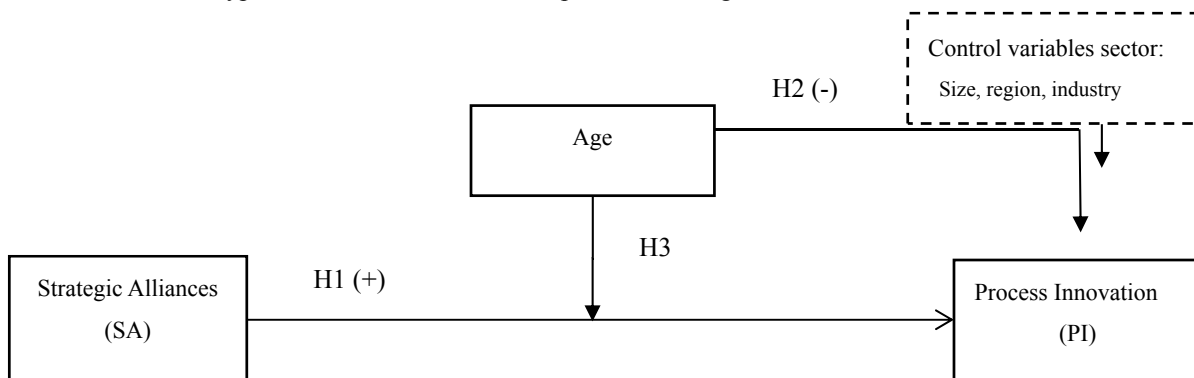All of the research hypotheses illustrated above are presented in Figure 1.

Figure 1. Schematic representation of a firm's alliance-process innovation model

6. Methodology

6.1 Sample and Data Collection

The Italian context represents a suitable environment for researching process innovation in small firms[1]. Italy contains one of the largest shares of small and micro firms in the EU (Cucculelli & Bettinelli, 2016; European Commission, 2013) and maintains a disproportionately large proportion of businesses with fewer than 15 employees (Melchiorre & Rocca, 2013) due to the employment protection legislation that implies less rigid rules for such firms. We retrieved information about the sample population of small firms from the Registry of the Businesses of the Italian Chambers of Commerce. We conducted a survey in collaboration with Italian public institutions[2] with the objective of developing a

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[1]We define small firms as those that have from 5 to 15 employees; this definition is consistent with previous literature shows that firms this size are the ones which may effectively have the potential of implementing some innovation (Çokpekin, 2012; Czarnitzki & Kraft, 2010; de Jong & Kemp, 2003).

[2]The survey was part of a project organized by several Italian public institutions and involved one of the authors of the paper. The public institutions involved in this research were the Italian Ministry of Economic Development, the Department for Equal Opportunities, and two bodies of the Italian Chambers of Commerce, Centro Studi Unioncamere and Retecamere. Silvia Biffignandi, one of the authors of this paper, was the scientific coordinator of the project. We

database on entrepreneurship and competitiveness characteristics of Italian firms. Structured questionnaires were used and a probabilistic sample stratified by sector, legal form, and geographic distribution was drawn up using proportional allocation criteria. The sample size was determined with a confidence interval of 0.3% and 95%, with an admitted relative error of 14% for rare cases beyond 5%. This led to the definition of a stratified sample of 3001 firms that, referenced to the adopted procedures of stratification, can be considered representative of the population of Italian firms (Lohr, 2009). The list of companies to be interviewed was randomly extracted from the Italian Chamber of Commerce list using these stratification criteria. Firms from this list were selected through the application of the following sampling step: *k=N/n*. The survey was conducted using computer-assisted telephone interviewing (CATI) between May and July 2009. The interviews were all addressed to the CEO, in 19 cases the CEO was not available, and delegated either the general director or his/her major partner. Non-respondents were substituted, ensuring that the replacements belonged to same stratum (i.e., the same sector, legal form, and geographic distribution). Thanks to this approach the targeted sample size of 3 001 firms was entirely surveyed.

Given the objective of this paper, we extracted, from the above sample population, pertinent data on small firms, their alliances, and innovativeness characteristics. This resulted in a sample of 159 small firms, representing 5,3% of this firm category in the population of 3001 firms surveyed. Based on stratification process explained earlier, representativeness of our selected sample of firms is also supported by secondary data from ISTAT(2011). Specifically, according to ISTAT published reports on types and categories of firms in Italy, small firms make about 7% of the entire population of Italian firms, a proportion in line with the one we found in our extraction.

6.2 Variables and Measures

6.2.1 Dependent Variable

Inspired by Crossan and Apaydin (2010) and Damanpour (1991), and the empirical work of Cantner et al. (2010) and Piening and Salge (2015), we measured process innovation using an ordinal scale. The ordinal scale is built by asking whether or not, over the past year, the firm was engaged in any of the following process innovations: 1) introduction of machinery and new technologies, 2) purchase of patents and licenses, 3) innovation in the business organization, and finally, 4) development of new production methods. Each of these items[3] is anchored with (0) and (1) reflecting answers as (no) or (yes) respectively.

The final ordinal index of process innovation is from (0) to (4) and reflects 5 possible events (zero means no process innovation was introduced, one means, one of the four options of PI was introduced, two, means two of the four options of PI introduced three means three options of PI introduced and finally four means four options of PI introduced). A high score indicates a high propensity of PI. A total of 38.5 % of the sampled firms declared that they had implemented at least one innovation over the past year. This early result is in line with previous literature (e.g. Edwards, et al., 2005; Piening & Salge, 2015). Table (1) presents descriptive statistics of measures used in the model. The PI variable has a mean value of 0.49 (1.30 if we only included firms that introduced at least one innovation). Also, data indicates that the firms in the sample implemented process innovation activities from level of zero (no PI) up to two options of PI over the previous year.

6.2.2 Independent Variables

To investigate the effect of strategic alliances on innovation, we followed Nieto and Santamarìa (2010) and encoded the collaborative behavior of a firm as a dichotomous variable named *strategic alliances*. This equaled one if, over the past year, the firm had collaborated or taken part in joint initiatives within a network[4], and 0 otherwise. Our other independent variable, firm *age,* was the number of years from establishment to data collection.

6.2.3 Control Variables

As geographical location of firms can produce positive knowledge externalities for growth and innovation (Marshall, 2004; Romer, 1990) and affect learning processes for innovation (Antonelli, 1998; Porter, 1998), we controlled for it by including in our model the dummy variables North-East, North-West, and Central that equaled one if the firm was

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[3] These items correspond to F.1.1., 1.2, 1.3, 1.4 in the questionnaire

[4] These items correspond to E 9 and F 2 in the questionnaire

located in one of these parts of Italy and zero otherwise[5].

Firm sector is considered as a common control variable that could contribute to the variability of innovation activity, (e.g. Dagenais and Mohnen, 2000; Tsai, 2001) so we included two dummies, *manufacturing* and *commerce and services* to control for firm sector[6]. Finally, we controlled for firm size, because this can also explain innovation (e.g. Acs & Audretsch, 1987; Scherer, 1965; Vaona & Pianta, 2008). *Firm size* was measured as the number of employees active in the company (Bertschek & Entorf, 1996; Vaona & Pianta, 2008).

When surveys are used to collect data at the same time from the same persons, common method variance (CMV) may be a concern. Evidence shows that this concern is stronger when both the dependent and focal explanatory variables are perceptual measures derived from the same respondent (Podsakoff & Organ, 1986; Spector, 2006). The variables measured in our study are not perceptual as they refer to exact firm characteristics and/or actions taken rather than to perceived constructs. As it is noted in the literature, more fact-based questionnaire items are less likely to be associated with CMV (Podsakoff, MacKenzie, Jeong-Yeon, & Podsakoff, 2003). This is why CMV should not be a major cause of concern (Chang, van Witteloostuijn, & Eden, 2010). Nevertheless, in this study we adopted various strategies to minimize any potential CMV bias. First, measures for different variables were gathered from different sources. In particular, sector, region, firm size and firm age where included in the Italian Chambers of Commerce database used to create the lists of contacts, while strategic alliances and process innovation where gathered thanks to the survey. Thus, most of the variables were collected from a different source than the dependent variable(s) are collected from (Chang et al., 2010). Second, respondents were assured of the confidentiality of the study, that there are no right or wrong answers, and that they should answer as honestly as possible (Chang et al., 2010).

Table 1. Descriptive Statistics for the variables included in the model (raw data).

Construct	Minimum	Maximum	Mean	Std. Dev.
Process innovation	0	2	0.49	0.68
Firm size	5	15	6.90	2.49
Strategic alliances (SA)	0	1	0.18	0.39
Firm age	1	52	19.69	11.00
	Relative Frequencies (%)			
Manufacturing	30%			
Commerce and Services	52%			
Agriculture	18%			
North- East	18%			
North-West	29%			
Central	19%			
South Italy and Islands	34%			

N= 159

7. Results

To test our hypotheses, we ran ordinal regression analyses commonly used when the dependent variable is ordinal (in this case from 0 to 4) in order to consider the probability of that event and all others above it in the ordinal ranking. We structured our analysis in steps, with variables entered sequentially in the regression models. For each step, we retained the variables from the previous model to measure the added variance explained. Table 2 presents correlations for each of the measures. Correlation results indicate empirical support for hypothesis 1 (H1), by showing a positive relationship between strategic alliances and process innovation ($\rho = 0,545$, $p < 0,01$), a result to which we will return later. As Table 2 shows, correlations among the independent variables suggested that multicollinearity was unlikely to be a problem. The assumptions made in an ordinal regression modeling were respected by our data, which showed that the proportional odds assumption was appropriate according to the test of parallel lines[7].

The results of the regression analysis are shown in Table (3). We started with *Model 1*, where we tested whether the control variables *industry*, *geographical area* and *size* concurred in predicting process innovation. The results showed that the control variables were not significant. Hypothesis one predicted a positive relationship between strategic alliance and PI, that is, collaborative firms perform more process innovation than firms that did not collaborate with others. The results confirmed this, with a positive relationship between collaborative behavior and the dependent variable. These findings echoes with studies that emphasize the importance of taking part in strategic alliances to better achieve PI. Thus, to ally with another firm, may be one solution to overcome the barriers to develop PI   (Das & Teng,

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[5]South and Islands were the reference point for interpretation of results.

[6]Firms belonging to the Agriculture sector were the reference point for interpretation of results.

[7]Additional information is available from the authors.

2000; Hewitt-Dundas, 2006). Our final hypothesis predicted that firm age would have a moderating effect on the relationship between strategic alliance and PI. Interestingly, the moderating effect of firm age appears statistically significant. While company age *per se* did not significantly relate to PI, it emerged as a significant inter-player in the association between strategic alliances and process innovation. The difference in fit between model two and model three (which considered the interaction effect of age) indicated that the coefficient of moderating variable goes beyond the existent variables in explaining variance. Figure (2) illustrates a plot of this significant relationship.

Our independent variable (strategic alliances) was categorical and the moderator (age) continuous. As such, we followed the procedure recommended by MacCallum, Zhang, Preacher, and Rucker (2002) . To compare the extent to which a firm develops its process innovation while accounting for different age subgroups, we 'median split' our sample. We had two subgroups, those below the median age and those that are above. The variable *age* was therefore transformed into a categorical one with a young group of firms aged less than the median of the sample, and an old group with age equal to or above the median. Figure 2 shows the comparison of the extent of process innovation for the two subgroups and demonstrates that young firms benefit more than older ones from the increase in process innovation when they collaborate. The fit line representing younger firms has a higher slope than the fit line representing older firms. Additionally, as Figure 2 shows, if firms do not perform strategic alliances, the extent of PI is similar for the two subgroups.
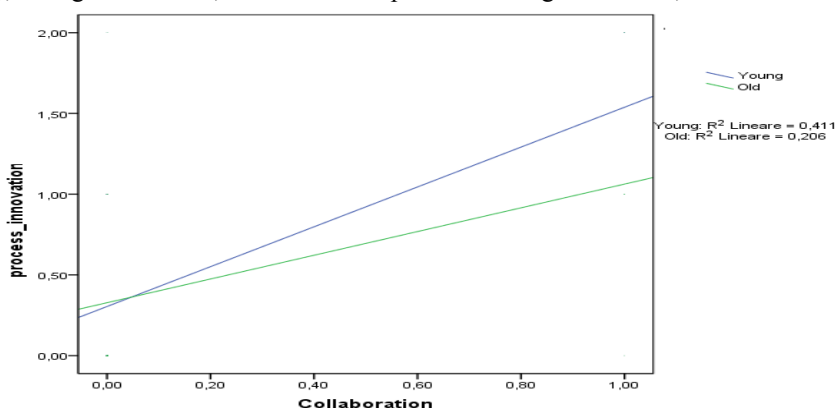

Figure 2. Interaction between strategic alliances and process innovation, with firm age plotted based on median split

Table 2, Correlations

	1	2	3	4	5	6	7	8	9	10	11
1 Agriculture[a]	1										
2 Manufacturing[a]	−0.311**	1									
3 Commerce and services	−0.487**	−0.679**	1								
5 North-East[b]	−0.012	−0.027	0.034	1							
4 North-West[b]	−0.122	0.154	−0.048	−0.301**	1						
6 Central[b]	0.055	0.057	−0.095	−0.232**	−0.314**	1					
7 South and Islands[b]	0.081	−0.174*	0.098	−0.334**	−0.451**	−0.348**	1				
8 Firm size	−0.099	0.082	0.001	−0.020	0.138	0.007	−0.122	1			
9 Strategic alliance (SA)	−0.054	0.115	−0.064	0.199*	−0.086	0.138	−0.196*	0.124	1		
10 Firm age	−0.108	0.171*	−0.074	−0.028	0.150	−0.113	−0.026	−0.079	0.042	1	
11 Process innovation (PI)	0.066	−0.091	0.033	0.090	0.029	−0.005	−0.098	0.148	0.545**	−0.018	1

N=159 ** Correlation significant at 0.01 level, * significant at 0.05 level (2-tailed) [a] Firms belonging to the Agriculture sector were the control group; [b] South and Islands were the reference point for interpretation of results

Table 3. Results of Ordinal Regression Analysis (dependent variable: Process innovation-PI)

	1			2			3		
	Beta	*S.E.*	*Wald*	*Beta*	*S.E.*	*Wald*	*Beta*	*S.E.*	*Wald*
Manufacturing [a]	0.794	0.491	2.621	1.315*	0.559	5.530	1.280**	0.555	5.318
Commerce and services [a]	0.348	0.429	0.658	0.438	0.452	0.939	0.513	0.460	1.244
North-East [b]	−0.730	0.467	2.438	0.224	0.538	0.173	0.235	0.545	0.186
North-West [b]	−0.470	0.431	1.193	−0.526	0.456	1.331	−0.551	0.454	1.470
Central [b]	−0.345	0.474	0.530	0.426	0.540	0.622	0.358	0.545	0.431
Firm size	0.100	0.063	2.502	0.074	0.069	1.144	0.078	0.069	1.261
Strategic alliances (SA)				**3.247***	0.520	38.937	**4.609***	0.978	22.230
Firm age				−0.007	0.017	0.202	0.009	0.019	0.224
(SA) x (firm age)							**−0.065***	0.038	2.916
Model X^2		7.360			54.42***			57.38***	
R^2 (Cox and Snell)		0.05			0.29			0.303	
R^2 (Nagelkerke)		0.05			0.35			0.364	

*** $p < .001$, ** $p < 0.05$, * $p < 0.10$ [a] Dummy variable, baseline: Agriculture [b] Dummy variable, baseline: South Italy and Islands,

8. Discussion and Implications

In this paper, we aimed to theoretically articulate and empirically test association between a firm alliance and its PI, and the role of firm age on this relationship. Our analysis of a sample of 159 small firms, representative of the Italian population of small firms, revealed that having an alliance with another firm is directly and positively associated with PI. This indicates that when firms strategically ally with a partner, this will favorably influence the extent to which it develops process innovation. We were able to demonstrate that firm age is a significant moderator in this relationship. Our data reflects that younger firms would benefit more from strategic alliances with other firms to extend and develop aspirations of process innovation, while older firms will gain less from such actions. We offer a pragmatic, though partial, resolution to linkage between process innovation and strategic alliances of small firms, on the one side, and liability of newness, as expressed by firm age, on the other.

The first finding, on the positive relationship between a strategic alliance and PI, confirms the view that alliances are important facilitators of innovativeness (Konsti-Laakso et al., 2012). For the analyzed firms, possible benefits such as risk sharing and access to complementary resources (Ahuja, 2000; Pittaway, Robertson, Munir, Denyer, & Neely, 2004) may exceed the negative aspects of strategic alliances such as organizational and cultural discrepancies, conflicting interests, differences in timing or contributions or loss of core competence to third parties.

Contrary to hypothesis (H2), the second finding shows no evidence to support the prediction that younger firms have a higher propensity to develop PI. This result recalls the current debate in the literature: while it is true that younger firms may be less incentivized to focus on PI since they face (compared with older firms) more constraints in access to resources and knowledge, and market position instability because of "newness" (Baum et al., 2000; Nelson & Winter, 1982; Stinchcombe, 1965); it is also true that older firms (compared with younger ones) may experience more organizational inertia and a "competency trap" (Levinthal & March, 1993) that make it difficult for them to adjust to a changing environment and introduce PI (Nelson & Winter, 1982; Nieto & Santamaría, 2010; Withers et al., 2011).

One reason that could explain our finding of a non-significant relationship between firm age and PI could be found in the fact that the extant literature does not seem to have completely reached an agreement yet on the direction of this relationship: it can well be that in different life cycles phases, there could be positive and negative forces at play that compensate each other thus making it impossible to detect clear and univocal effects. In addition, the specific context in which we perform the study could also play a role (Bergamaschi & Randerson, 2016), for example it is not significant in our sample but it could be in other contexts (e.g., in other geographic locations etc.). The third finding (confirming H3), show that younger small firms that engage in a strategic alliance benefit more from this partnership, than older ones, in promoting their process innovation. This suggests an alliance may help younger firms to overcome barriers of limited access to desired resources, and therefore, able to innovate more (Huergo & Jaumandreu, 2004a, 2004b). Also, younger firms typically have higher flexibility and dynamicity (Hannan & Freeman, 1984) that allow them to collaborate more effectively, and thus be more innovative (Mazzarol & Reboud, 2008). Another explanation of this finding is that young firms may have a relatively more open-minded approach, increasing the likelihood that they will identify and exploit innovation opportunities (Withers et al., 2011).

This paper offers two theoretical contributions. First, while research has greatly enriched our understanding of innovation and the importance of innovation for creating competitive advantage (Cucculelli & Bettinelli, 2015; Cucculelli, Bettinelli, & Renoldi, 2014; Dossena, Bassani, Bettinelli, & Sanz, 2012), process innovation as an outcome has perhaps been under-researched (Macher & Mowery, 2009; Piening & Salge, 2015). Our paper represents an attempt

to shed some light on the relationship between an alliance and PI, and in particular on the contingencies that contribute to its variability. Using RBV, we offer additional insights into the importance of sharing resources through alliances to overcome the liabilities of newness and develop process innovation. This shows that resources can be nurtured to achieve competitive advantage not only through internal processes, but also sharing, especially in the case of younger firms.

Strategic alliance is one of the pathways that a small firm adopts for sustenance and growth, and which mitigates the liabilities of newness. Our focus on PI departs from and extends the literature on innovation and alliances, which not only has treated partnering and process innovation as largely independent, but also left process innovation- as an outcome- relatively understudied (Crossan & Apaydin, 2010). In term of managerial implications, by confirming that an alliance with another firm is particularly beneficial for the development of process innovation, while accounting for age as a specific and important contingency, we offer a model that lends itself to managerial incentives on whether and how to manage partnerships and ultimately consideration of pertinent governance mechanisms. Our findings may also alert managers and decision makers in small firms that strategic decisions to ally and collaborate with other firms to develop process innovation are more likely to be successful at an early stage in the firm's life. From a practical point of view, by confirming that strategic alliances can be particularly beneficial, we provide an incentive for small firms to collaborate to achieve PI and governments to support them in this.

9. Limitations and Further Research

Like other studies, this research has limitations, and these results should therefore be interpreted with caution. First, our process innovation and strategic alliances variables may be an oversimplification of reality. In particular, our dependent variable measures process innovation but it does not measure whether the process innovation options are strictly connected to the fact of having performed a strategic alliance (i.e., the process innovation success of an alliance). Also, we operationalize our dependent variable with an index and measure strategic alliances with a dummy. While this approach   is relative common in large scale studies on innovation (Cantner, Conti, & Meder, 2010; Laursen & Salter, 2006) and on alliances (Mairesse & Mohnen, 2002; Nieto & Santamaría, 2010), it may potentially inhibit the power of the model in terms of offering a more nuanced view of the dynamics under study. This is why future research should explore these variables in a more refined way. Our data did not allow us to control for partnering firm's characteristics, for instance, their set of resources, competencies and capabilities,   geographic proximity or   the type of partner (e.g., large, old, etc.) may   play a role in completing the explanation of our dependent variable. In order to offer a more complete picture, future research could consider also these variables (i.e., partnering firm's features) that would be beneficial for our understanding.

In addition, the geographical context (Italy) of the studied firms is specific; and thus, interpretation of results needs to be taken with caution. This study could, however, be used as early evidence of a developed economy with an extended system of small firms, and the findings could be comparable, with due caution, to similar contexts. The data for this study is cross-sectional; therefore drawing definitive conclusions on causality is not warranted. A longitudinal study based on our proposed model could be useful to provide additional explanations and possible cause-effect relationships, if any, among the variables.

The approach of considering the moderating effects of firm age to give more details about an existing relationship allows the formulation of several other hypotheses for new research studies. Further investigation of the relationship between strategic alliances and innovation in small firms could include analysis of the moderating effects of other variables recognized as relevant. For example, it would be valuable   to explore the interaction effects emerging from the personal characteristics of the firm's leadership or its network, or to extend the focus to the moderating role of the industry and market structure in which the small firms operates. These suggestions are only examples of possible areas for future in-depth analysis, which would strengthen the knowledge and the managerial implications of the benefits of networking for innovation.

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